United States Patent

[11] **3,550,925**

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[21] Appl. No. **756,455**
[22] Filed **Aug. 30, 1968**
[45] Patented **Dec. 29, 1970**
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[54] **APPARATUS FOR SEPARATING METALS**
11 Claims, 3 Drawing Figs.

[52] **U.S. Cl.** **266/37,** 23/280; 210/69
[51] **Int. Cl.** **C21d 1/34**
[50] **Field of Search** 23/280; 266/33, 34, 37; 214/21; 209/11, 182; 210/69, 189

[56] **References Cited**

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1,938,239	12/1933	White	23/280
1,884,860	10/1932	Rector	210/69
3,180,880	4/1965	Harrison et al.	23/280
3,193,273	7/1965	Miller et al.	266/37
3,401,925	9/1968	Evans et al.	266/37

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ABSTRACT: This invention relates to an apparatus for separating metals and particularly to an apparatus for separating two different alloys from scrap metal. The apparatus includes a retort mounted for rotation within a gas furnace and a spiral flight is secured to the inner wall of the retort. The scrap material is charged into the upper end of the retort and is carried downwardly through the retort by rotation of the spiral flight. During travel through the retort, the lower melting point alloy is melted and the molten alloy is discharged from the retort through a screen adjacent the lower end of the retort, while the unmelted higher point alloy is conveyed across the screen and discharged from the lower end of the retort into a receptacle.

The furnace extends longitudinally beyond the screen section of the retort and the gases of combustion from the furnace are drawn through the screen into the retort, and flow through the retort to its upper end to provide an increased efficiency of heating.

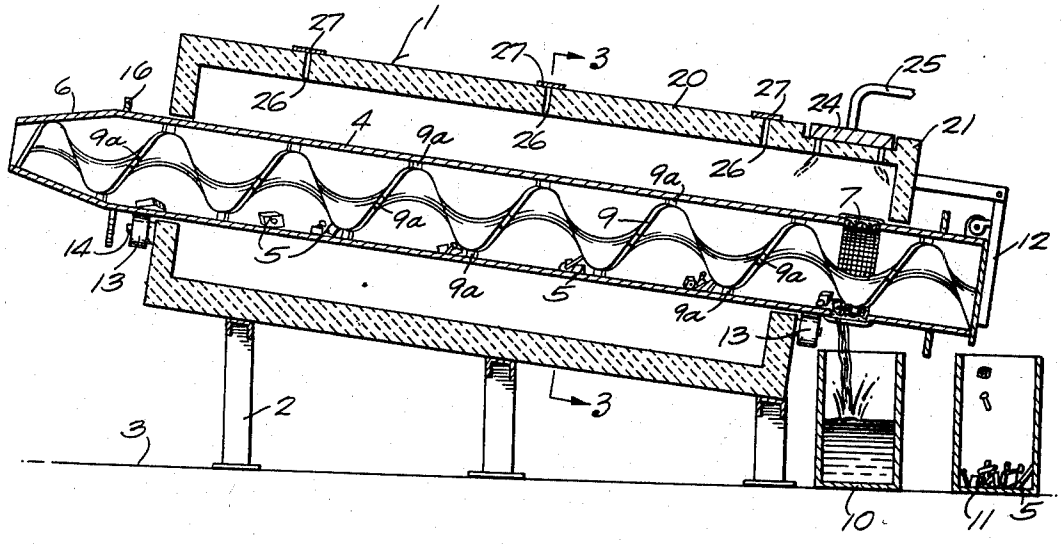

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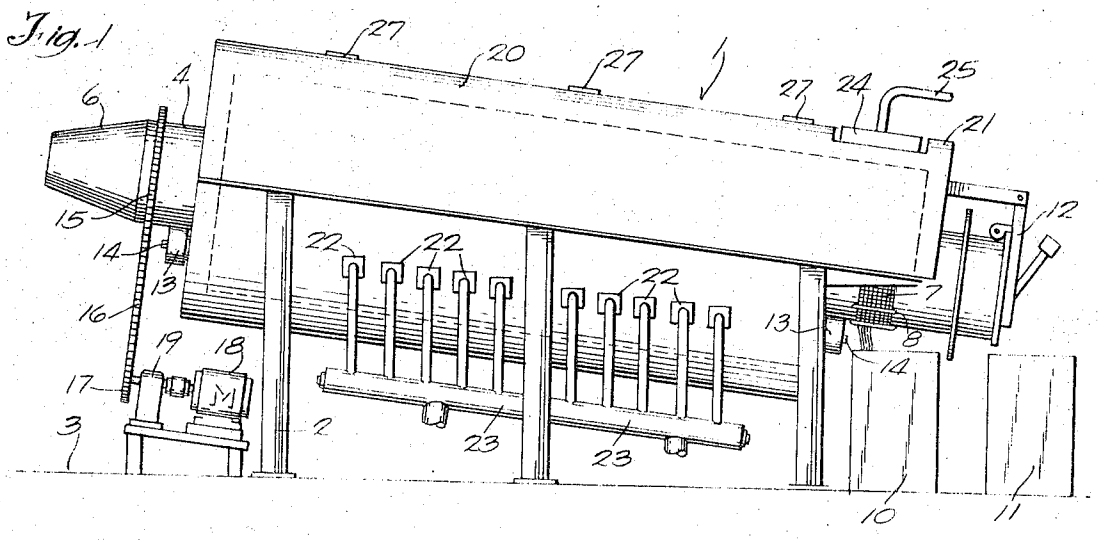
Fig. 1



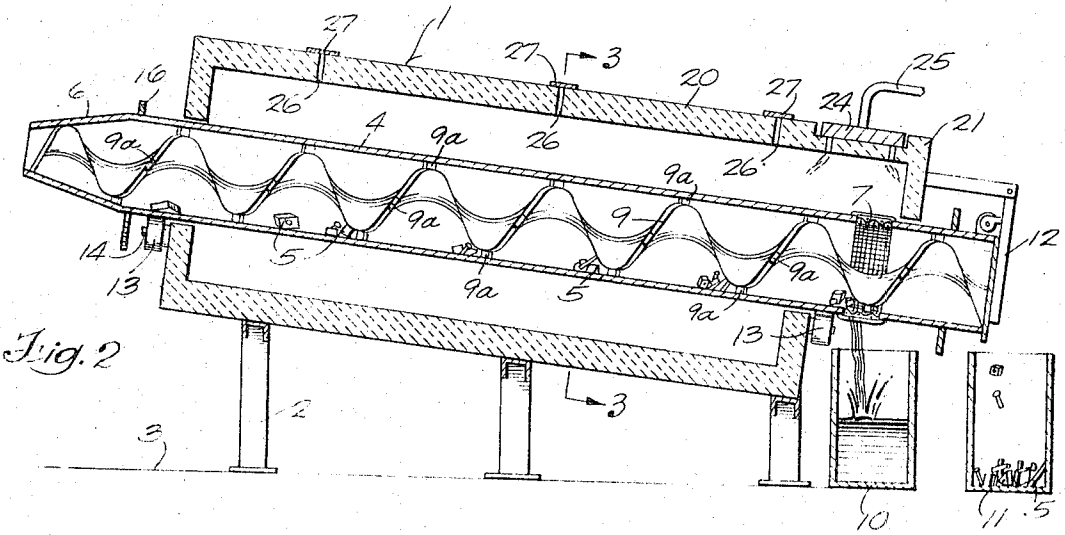


Fig. 2

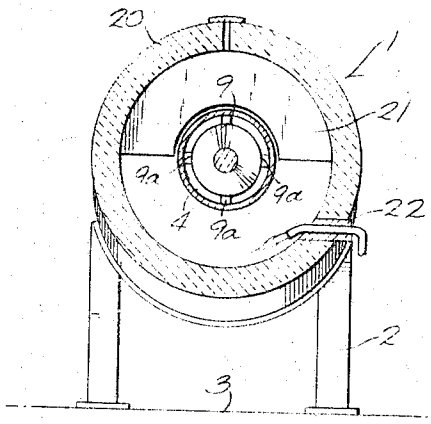


Fig. 3

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APPARATUS FOR SEPARATING METALS

Scrap metal in many cases consists of two or more different alloys, and unless the various alloys are separated, the scrap metal has little value. For example, zinc or aluminum alloy die castings generally contain small elements of iron or steel such as pins, bushings, screws, bolts, jets, etc., which cannot be readily separated from the die cast alloy except through the use of expensive manual labor. These die cast alloys containing the small iron or steel parts have very little value for scrap purposes and processes have been devised in the past in an attempt to economically separate the die cast alloys from ferrous metals.

U.S. Pat. No. 3,193,273 relates to an apparatus for separating two alloys from scrap metal in a continuous process. The metal separating apparatus of that patent includes an inclined tube or retort which is mounted for rotation within a furnace and a spiral flight or auger blade is secured to the inner wall of the retort. Scrap metal is charged into the upper end of the retort and is carried downwardly through the rotating retort by the spiral flight. The lower end of the spiral flight extends outwardly beyond the rotating tube and a screen or other member of open construction is located at the lower end of the tube and the molten lower melting point alloy is discharged through the screen into a container for collection, while the unmelted, higher point alloy pieces are conveyed across the screen and collected in a second container.

The present invention is directed to an improvement to the structure shown in U.S. Pat. No. 3,193,273 and is directed to the concept of circulating the gases of combustion through the retort to increase the efficiency of heating. According to the invention, the low end of the inclined tube or retort is provided with a screen section, and the molten lower melting point alloy flows through the screen to a collection container, while the unmelted higher melting point alloy pieces are moved across the screen by the spiral flight and discharged from the end of the tube into a second collection container. In the apparatus of the invention the upper portion of the furnace wall extends longitudinally beyond the screen section of the retort and a separate radiant gas burner is located in the upper portion of the furnace above the screen. With this construction, the screen of the retort is maintained at a high temperature so that the molten alloy will not solidify and clog the openings in the screen. Moreover, the gases of combustion which flow along the top wall of the furnace are drawn through the screen into the retort and then flow upwardly through the retort to its upper end. This circulation of the hot gases of combustion within the retort aids in heating the scrap to a higher temperature with less consumption of fuel.

As the combustion gases are generally nonoxidizing gases, the circulation of the combustion gas through the retort will also tend to minimize the amount of oxygen in the retort and thereby reduce the possibility of oxidation of the materials.

The radiant gas burner which is located above the screen section at the end of the furnace aids in maintaining the end of the retort in a heated condition so that the molten metal will not solidify as it passes through the openings in the screen section of the retort.

The process of the invention produces a clean metal separation in which the unmelted pieces of the higher melting point alloy are relatively free of oxides and scum. Due to the tumbling action provided by the spiral flight, the softer metals and oxides are knocked off of the harder metals so that a mechanical separation is also provided by the apparatus.

Using the furnace construction of the invention, a very close temperature control can be obtained so that oxide formation is minimized and there will be no appreciable loss of metals due to the oxide formation.

Other objects and advantages will appear in the course of the following description.

The drawings illustrate the best mode presently contemplated of carrying out the invention.

In the drawings:

FIG. 1 is a side elevation of the metal separating apparatus of the invention;

FIG. 2 is a vertical section of the apparatus; and

FIG. 3 is an end view of the apparatus.

The drawings illustrate an apparatus for separating scrap metal into its alloy components and comprises a furnace 1 which is supported on a frame 2 mounted on a foundation 3. A generally cylindrical retort 4 is mounted for rotation with the furnace 1 and scrap material 5 to be heated is introduced into the retort 4 through an inlet 6. The lower end portion of the retort 4 is provided with a screen section 7 which extends around the entire periphery of the retort. The screen 7 can be any type of foraminous member of open construction capable of withstanding the temperatures involved and the screen is supported by a series of reinforcing members 8 that extend longitudinally across the screen.

The scrap pieces 5 are adapted to be conveyed through the retort 4 by rotation of a spiral flight 9 connected to the inner wall of the retort by a series of spacers 9*a* which provide passages between the retort and the spiral flight. During the period that the scrap 5 is in the furnace, the lower melting point alloy will be melted and the molten alloy flows downwardly through the passages between spacers 9*a* and then through the openings of the screen 7 and is collected in a container 10, while the unmelted higher melting point alloy pieces are conveyed across the screen 7 by a spiral flight 9 and are discharged from the low end of the retort into a second container 11. The end of the retort can be closed off during periods when scrap is not being moved through the retort by a hinged cover 12.

The retort 4 is journaled for rotation about its axis on two pair of rollers 13 which are mounted on shafts 14 that are journaled within the end walls of the furnace 1.

To rotate the retort 4, a sprocket 15 is secured to the outer surface of the retort and is connected by chain 16 to a drive sprocket 17. Sprocket 17 is driven by a motor 18 acting through a conventional speed reducing mechanism 19.

The furnace 1 includes a generally cylindrical central section 20 and a semicylindrical extension 21 which extends outwardly from the end of the central portion 20 and is located above the screen 7.

The scrap material 5 is heated by conduction, radiation and convection within the retort which is in turn heated by a series of gas jets 22 which are located in the wall of the central section 20 of furnace 1 and are positioned at spaced intervals along the length of the furnace. The gas jets 22 are arranged so that the flame is directed generally tangentially to the retort and the flame does not play directly on the retort 4. Gas is introduced to the jets 22 through a manifold 23 which in turn is connected to the gas supply lines by a conventional pipe system.

In addition to the gas jets 22, a radiant burner 24 is mounted in the upper portion furnace extension 21 and is located generally above the screen 7. Gas is supplied to the burner 24 through a gas line 25. The burner 24 directs a generally flat flame along the wall of the extension 21 and provides a more uniform temperature throughout the entire length of the furnace. By maintaining the low end of the retort, including screen 7, at an elevated temperature, the molten metal can pass freely through the screen without danger of solidification in the screen openings.

During the heating operation, the gases of combustion from both the gas jets 22 and the burner 24 will be drawn through the screen 7 into the lower end of the retort 4 by a chimney-type of action. The gases of combustion then pass upwardly through the retort, countercurrently to the flow of scrap 5, and are discharged from the inlet end 6. As the hot gases of combustion pass upwardly within the retort, the efficiency of heating of the scrap metal 5 is improved, thereby enabling the scrap to be heated to the desired temperature with a lesser consumption of fuel.

The amount of combustion gas being drawn into the retort 4 through screen 7 can be controlled by means of vents 26 which are located in the upper surface of the furnace 1. Suitable lids or covers 27 can be used to close off the vents 26 as desired. By closing the vents, additional quantities of the gases of combustion will pass through the screen 7 into the retort 4

to increase the temperature within the retort, while opening the vents will cause an increased volume of the gases of combustion to escape through the vents 26 to the atmosphere and thereby decrease the temperature in the retort.

In operation, the scrap material 5 is charged into the inlet end 6 of the retort 4 and the scrap is conveyed to the low end of the retort with a tumbling type of action by the spiral flight 9. As the scrap travels within the retort and the lower melting point alloy, such as zinc or aluminum base alloy, is melted while the higher melting point alloy, such as steel or cast iron, will not melt. When the molten metal reaches the lower end of the retort, it flows through the screen 7 and is collected within container 10, while the unmelted pieces of the higher melting point alloy are conveyed across the screen by the spiral flight and are discharged from the low end of the retort into the container 11.

The tumbling action provided by the rotating tube in the spiral flight tends to separate the low melting point materials from the higher melting point materials by a mechanical action as well as by the melting action. The tumbling action also results in both the molten metal and the unmelted scrap particles being in a relatively clean state, free of oxides and scum.

As the scrap is not directly heated but is contained within the rotating retort, a more accurate control of the temperatures can be obtained and this results in a minimum oxide formation and loss of metals in the form of oxides.

While the furnace extension 21 is shown as being generally semicylindrical and encompassing approximately 180°, it is contemplated that the extension may extend circumferentially through a greater arc as long as an opening is provided in the extension through which the molten metal can be discharged from screen 7 into the container 10.

Similarly, while the above description is directed to a metal separating apparatus in which the scrap is charged into the upper end of the container and moved downwardly, it is contemplated that the apparatus may be arranged so that the scrap is fed into the lower end and is moved upwardly. In that case, the apparatus can be similar to that shown in the copending Pat. application Ser. No. 491,139, filed Sept. 29, 1965 and now U.S. Pat. No. 3,401,925, and entitled Apparatus for Separating Materials, with the furnace extension or hood extending beyond the low end of the retort so that the combustion gases will be directed into the low end of the retort.

Various modes of carrying out the invention are contemplated as being within the scope of the following claims particularly pointing out and distinctly claiming the subject matter which is regarded as the invention.

We claim:

1. In an apparatus for separating metals, an inclined retort disposed to convey a material composed of a higher melting point substance and a lower melting point substance, conveying means located within the retort for conveying the material from one end of said retort to the other end, a furnace disposed around the retort, gas-fired heating means located within the furnace for heating the material to a temperature above the melting point of the lower melting point substance to melt the same and to a temperature beneath the melting point of the higher melting point substance, said retort having a discharge outlet at its low end for the discharge of the molten lower melting point substance, and means for conveying the gases of combustion from said heating means into the discharge outlet of said retort, said gases passing upwardly through the retort and being discharged from the high end of the retort.

2. The apparatus of claim 1, wherein said discharge outlet is enclosed by a foraminous member.

3. The apparatus of claim 1, wherein said discharge outlet is an opening extending circumferentially of the retort, and said apparatus includes a screen disposed across the opening, the molten lower melting substance being discharged through the screen to a collection container.

4. The apparatus of claim 1, and including adjustable vent means associated with said furnace for controlling the flow of the gases of combustion through said discharge outlet and into the retort.

5. In an apparatus for separating metals, an inclined retort disposed to convey a material composed of a higher melting point substance and a lower melting point substance, a spiral flight secured to the inner surface of the retort, means for rotating the retort about its axis with said spiral flight acting to convey the material from one end of the retort to the other end, a foraminous member located at the low end of the retort, a furnace disposed around the retort, gas-fired heating means located within the furnace for heating the material to a temperature above the melting point of the lower melting point substance to melt the same and to a temperature beneath the melting point of the higher melting point substance, the molten lower melting point substance being discharged from said retort through said foraminous member, said furnace including a central section spaced radially outward of the retort and having an end section extending longitudinally from said central section and above the foraminous member, the upper surface of said end section being substantially continuous with the upper surface of said central section whereby the gases of combustion from said heating means are drawn from said end section through said foraminous member to the retort and thereafter pass upwardly through the retort to its high end.

6. The apparatus of claim 5, wherein said end section of the furnace extends axially beyond at least a portion of said foraminous member.

7. The apparatus of claim 5, wherein said retort is provided with a circumferential opening between the ends of the retort and said foraminous member is a screen which extends longitudinally across the opening.

8. The apparatus of claim 5, wherein said end section extends circumferentially less than 360°, and the bottom of the end section is open.

9. The apparatus of claim 5, and including second gas-fired heating means separate from said first heating means disposed within the end section of said furnace and located substantially above the foraminous member.

10. The apparatus of claim 5, wherein said central section of the furnace is generally cylindrical and the end section of the furnace is generally semicylindrical, the radius of said central section being substantially equal to the radius of said end section.

11. The apparatus of claim 5, and including means for spacing the peripheral edge portion of the spiral flight from the retort to provide a passage therebetween, the molten lower melting point substance flowing downwardly through said passage to said low end of the retort.